

Solenoid Valves

Product Bulletin 30-01

Type: S4W

Size: 20 - 50 mm ($\frac{3}{4}$ " to 2")

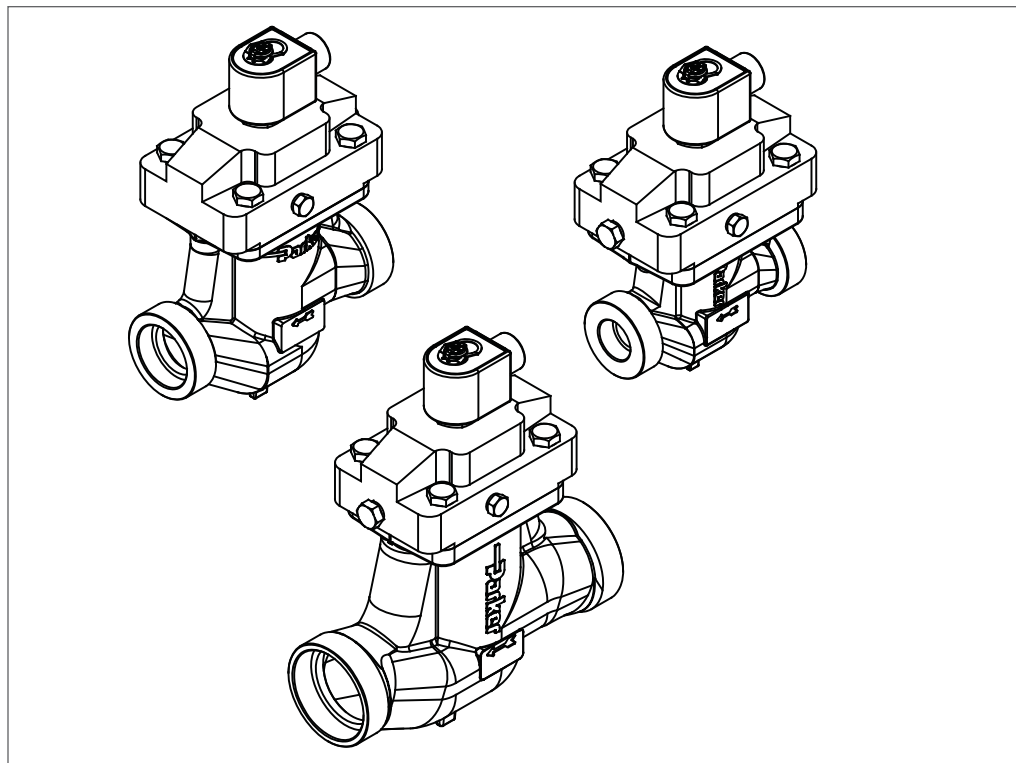
Design Pressure Rating: 32 bar (464 psig)

Maximum Operating Pressure Differential: 21 bar (300 psig)



Purpose:

The S4W is a spring closing valve suitable for use in refrigerant liquid, hot gas, or suction lines, whose primary purpose is to stop flow of refrigerant. The S4Ws most beneficial features are its stainless steel and aluminum construction, which allows it to withstand corrosive environments and its overall light weight minimizes installation costs.



Contact Information: Product Features:

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- Suitable for Ammonia, CO₂, R-22, R-404a, and other common refrigerants
- Designed with corrosion resistant material – 304 stainless steel and aluminum
- No body wearing surfaces
- Stainless steel components are resistant to wire drawing
- Design drastically reduces foreign material to solenoid and piston cavity
- Light weight
- Can be mounted in a horizontal and vertical position
- Fluid temperature rating: -60°C to 116°C (-76°F to 240°F)
- Ambient temperature rating: -40°C to 60°C (-40°F to 140°F)
- Complies with Pressure Equipment Directive 97/23/EC



Patent Pending

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Description

All S4W solenoid valves are pilot operated and use the pressure drop across the valve for the opening force. A minimum of 0.14 bar (2 psig) pressure drop across the valve is required to fully open. The valves are an integrated assembly of two modules:

1. A body, which contains the modulating plug, but is ordered to suit a particular connection size. The port size defines the size of the body;
2. A port plate, which defines the valves function.

The S4W is a normally closed valve furnished with socket weld and weld neck options only. This unique design allows the regulator to be welded into the line without disassembly, yet provides full access for cleaning and servicing from the top only.

These valves are generally ordered with close upstream strainer to prevent entrance of foreign material into the valve and the rest of the system. (See Bulletin 00-20 for more information)

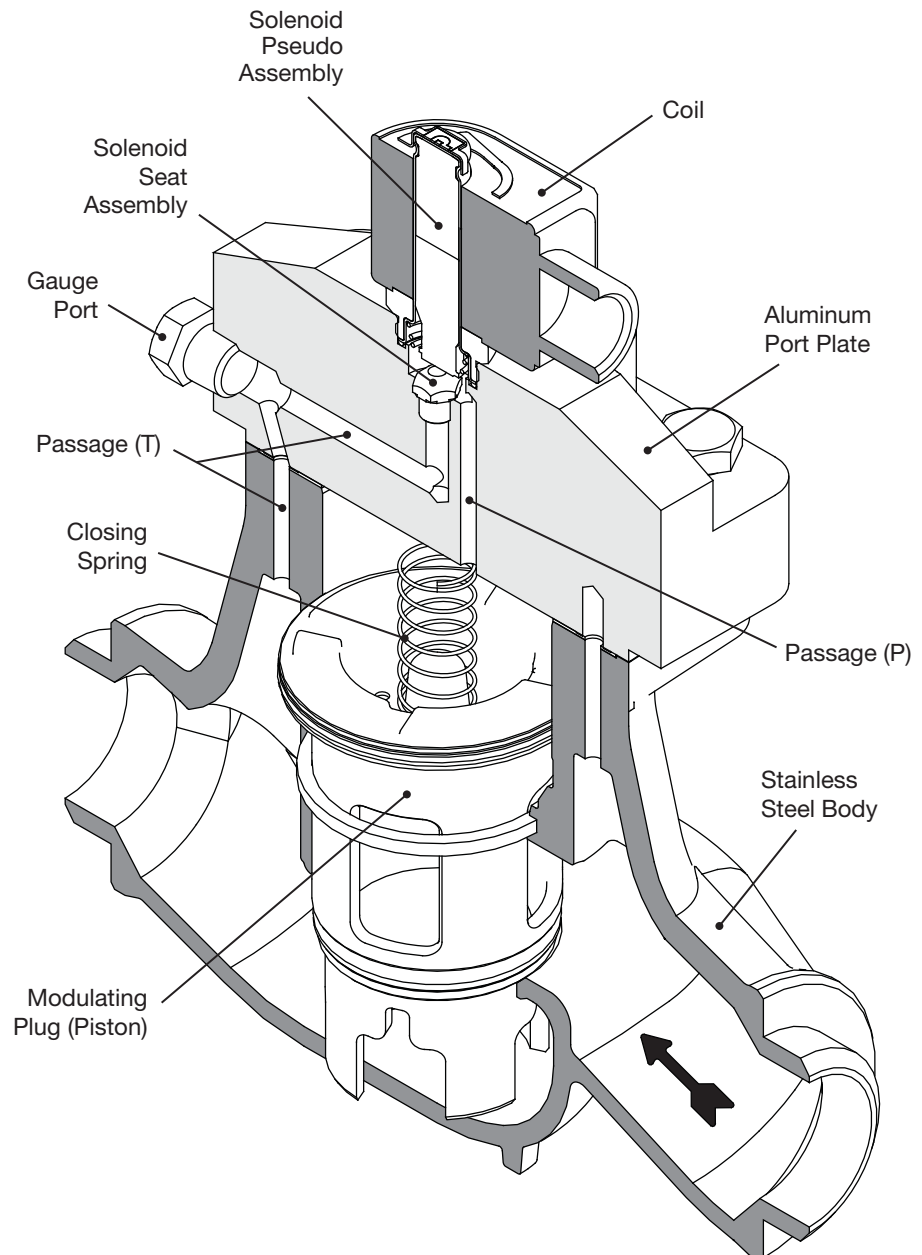
Principle of Operation

The S4W, pilot operated solenoid valve, is in the closed position when the solenoid coil is de-energized. The plunger needle assembly and main seat assembly are seated, preventing the pressure on top of the piston from going to the outlet side of the valve through passage (T). The inlet pressure enters the valve filling the areas inside the piston and inlet. A bleed hole in the piston allows for the continuous equalization of inlet pressure to the top of the piston. A piston seal ring ensures that this bleed hole is the sole source of equalization. The top and bottom pressure on the piston equalizes and the weight of the piston along with the closing spring forces the valve to close. The pressure above the piston prevents the piston from moving upward.

When the solenoid coil is energized, shown in the in the S4W solenoid valve cross-section, the magnetic field created pulls the plunger up and

Port Size	Connection Size (SW and BW only)	Body Size	Kv	Cv
20 mm (3/4")	3/4", 1"	1"	10.8	12.6
25 mm (1")	3/4", 1", 1-1/4"	1", 1-1/4"	12.5	14.6
32 mm (1-1/4")	1-1/4", 1-1/2"	1-1/4", 2"	22.3	26
40 mm (1-1/2")	1-1/2", 2"	2"	30	35
50 mm (2")	1-1/2", 2"	2"	41.1	48

S4W Port, Connection, and Flow Coefficient Table



Note: the manual opening stem is not shown in this cross-section.

S4W Solenoid Valve Cross Section (1-1/2" Valve Body Shown)

Passage	Description
N	Inlet Pressure
P	Piston Pressure, Top
T	Outlet Pressure
M	Manual Opening Stem

S4W Port Plate Passage Table

unseats the needle. This allows flow from the top of the piston, passage (P), to the valve outlet, passage (T), lowering the pressure on top of the piston. The lowering of the pressure above the piston combined with a higher inlet pressure causes the piston to move upward, opening the valve.

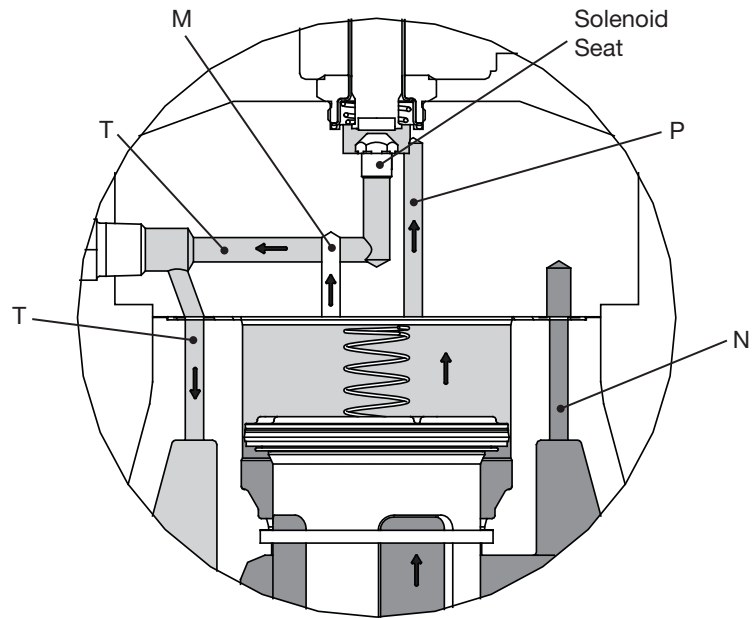
Manual Opening Stem

These valves are equipped with a pressure driven manual opening system versus the mechanical screw thread mechanism. A small valve is opened allowing the inlet pressure trapped above the piston to escape via passage (M), through the solenoid seat assembly and into passage (T), the valve outlet. The small valve stem is located on the side of the port plate as shown in the S4W manual opening stem cross-section diagram. Using a screw driver, turn the CCW to manually open the valve. Turn the stem CW to put the valve back into automatic operation. There must be at least a 2 psi pressure drop across the valve to completely open the valve. If there is less than a 2 psi pressure difference available the valve will be partially open and at some point less than 2 psi will close. There is still a leak path between the valve inlet and outlet through the manual opening valve for pump down purposes.

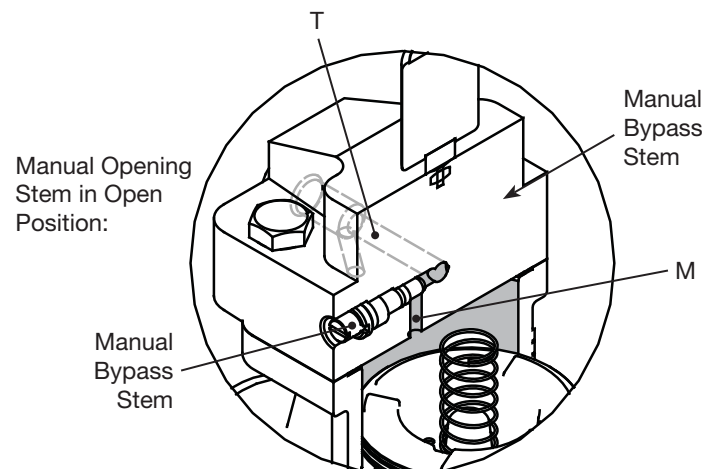
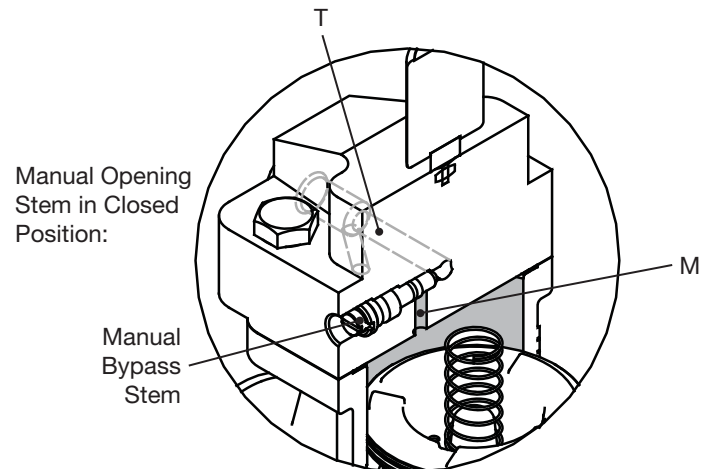
Installation

All solenoid valves are packed for a maximum protection. Unpack carefully. Check the carton to make sure all items are unpacked. Save the enclosed instruction for the installer and eventual user.

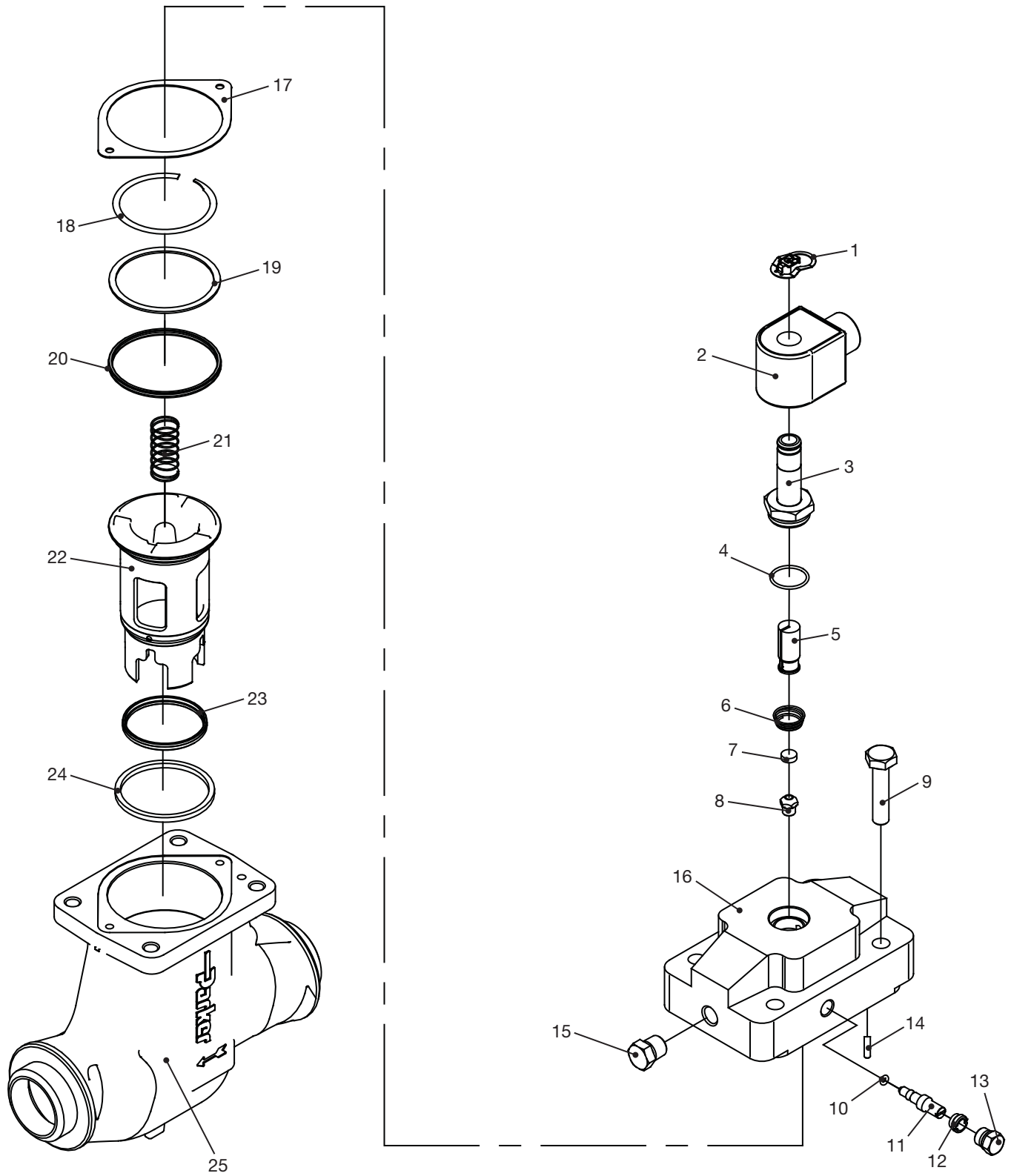
Do not remove the protective coverings from the inlet and outlet of the solenoid until the solenoid is ready to be installed. Protect the inside of the regulator from dirt and chips before and during installation.



S4W Principle of Operation Cross Section (Coil Energized)



S4W Manual Opening Stem Cross Section



S4W Exploded Parts View

Item No.	Description	Material	Qty
1	Clip, Coil	S.S.	1
2	Coil	-----	1
3	Solenoid Pseudo Assembly	S.S.	1
4	O-Ring, 0.813 ID x 0.938 OD x 0.062	Neoprene	1
5	Armature, Coil	S.S.	1
6	Spring, Coil	S.S.	1
7	Seal, Coil	Teflon	1
8	Seat, Solenoid	303 S.S.	1
9	Bolt, M10 x 45MM	DIN-ISO Standard 3506-1	4
10	O-Ring, 0.125 ID x 0.25 OD x 0.062	Neoprene	1
11	Stem, Manual Opening	303 S.S.	1
12	Nut, Retainer	416 S.S.	1
13	Plug Cap, Manual Opening 7/16-20	6061-T6 Al	1
14	Pin, Roll	420 S.S.	1
15	Plug, Gauge 1/4" NPT	PTFE Coated Steel	1
16	Port Plate	6061-T6 Al	1
17	Gasket, Port Plate	MP 15	1
18	Ring, Retaining 2.174 Internal	302 S.S.	1
19	Ring, Backing	302/304 S.S.	1
20	Ring, Seal 2.528 ID x 2.706 OD	PTFE S.S.	1
21	Spring, Piston	Music Wire ASTM A-228	1
22	Piston	303 S.S.	1
23	Ring, Seal 1.8 ID x 2.02 OD	Teflon (PTFE)	1
24	Ring, Wear	PTFE EMS-103	1
25	Body	304L S.S.	1

The valves should not be disassembled before welding. This grade of stainless steel is a poor conductor of heat and conventional weld processes (stick, MIG, and TIG) do not create enough heat that transfers to the valve's internal parts that could be affected.

Contractors need to follow a WPS (Welding Procedure Specification) for all welding. The procedure must be qualified and welder doing the weld qualified to perform that procedure. For welding the stainless steel 304L body to carbon steel pipe, E309L and ER309L-15,-16, or -17 filler metal is a common choice. Contractors can develop their own standards and have them qualified based on the equipment they use and the environment they may encounter.

The codes applicable to the welding of socket weld valves require that the pipe be inserted into the socket until bottomed against the stop. The pipe is then to be backed out approximately 1/16 of an inch before welding. Use of welding rings is optional, but recommended for butt weld valves. They help alignment, control gap for full penetration welding, and reduce welding debris entry.

S4W Parts List

Item No.	Kit Description	Port Size				
		20 mm (3/4")	25 mm (1")	32 mm (1-1/4")	40 mm (1-1/2")	50 mm (2")
14	Gauge Plug	208848	208848	208848	208848	208848
10 - 13	Manual Opening Stem	208809	208809	208809	208809	208809
8, 10 - 16	Port Plate	208849	208849	208849	208849	208849
17 - 24	Piston	208778	208779	208780	208781	208782
17 - 21, 23 - 24	Wear Seal, Piston	208819	208819	208820	208821	208821
4, 10, 17 - 20, 23 - 24	Gasket / O-Ring	208850	208851	208852	208853	208854
9	Bolt, Port Plate	208801	208801	208801	208801	208801
3 - 7	Solenoid Pseudo	208940	208940	208940	208940	208940
1 - 2	Coil, 120/60 or 110/50 18.5 Watt Leaded	204843	204843	204843	204843	204843
1 - 2	Coil, 240/60 or 220/50 18.5 Watt Leaded	204844	204844	204844	204844	204844
1 - 2	Coil, 208/60 18.5 Watt Leaded	204845	204845	204845	204845	204845
1 - 2	Coil, 240/50 18.5 Watt Leaded	204846	204846	204846	204846	204846
1 - 2	Coil, 24/60 18.5 Watt Leaded	206244	206244	206244	206244	206244

S4W Repair Kits

Note: When welding carbon steel and stainless steel the welded joint should be painted to prevent galvanic corrosion.

Socket welding where allowed is the preferred connection. This connection does help to reduce the amount of welding debris in the piping system.

Welded valves may be installed in horizontal or vertical pipelines. In a horizontal pipeline the valve can be mounted 90 degrees to either side from the upright position. These valves can not exceed below the 3-O'clock and 9-O'clock positions. It is important that the valves are installed in the correct direction of flow.

Before putting valves into service, all pipe connections, valve seats, and stem seals should be tested for leaks at pressure levels called for in appropriate codes.

Disassembly
(See also Bulletin RSBCV)

All S4W solenoid valves can be disassembled and all serviceable and moving parts replaced without disturbing the piping, but of course, disassembly will cause exposure of some section of piping to atmosphere, which should be addressed before disassembly by evacuation and re-claim of the refrigerant.

Note: to disassemble the valve it is not required to remove the coil pseudo assembly (#3 - #6) if it does not required replacement.

To remove the lower sub-assembly unfasten bolts (#8) retaining the lower sub-assembly. Removal of the port plate (#15) may require a sharp tap on their sides to unseat the parts from their sealed position, for which a rubber or rawhide hammer is recommended so as to avoid damage to the sealing surfaces. Removal of the port plate will expose the top of the piston. The piston spring (#20) and piston (#21) should be removed and inspected. Continue to inspect the wear ring (#23), metal rings, and gaskets.

Before re-assembly, all parts must

be cleaned with a suitable solvent, permitted to dry, and lubricated with a light film of refrigerant oil, simply wiped on with the fingers, All gaskets and o-rings should be renewed, and insertion and sealing will be facilitated if a similar film of oil is applied to them as well.

Re-assembly is exactly the reverse of disassembly, with the precaution that the reliefs cut into each module of the valve assembly and the corresponding gaskets be aligned with the appropriate location. Ensure that all access fittings, solenoid features, and bypass plug are sealed when re-installing the corresponding parts. Prior to installing the port plate inspect the piston, using your hand, by pulling up and pushing down. The piston should move freely, without dragging or hesitation. Adjust all torques to the values indicated by torque requirement table.

Tighten all bolts equally to draw the assembly together evenly, to ensure properly sealing of all joints.

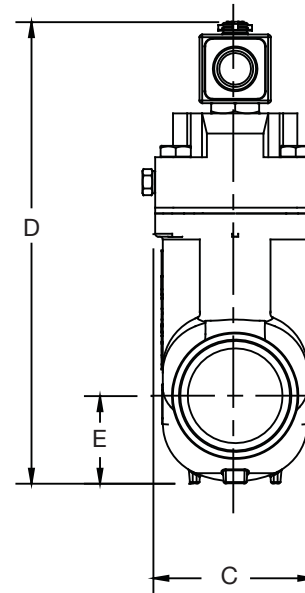
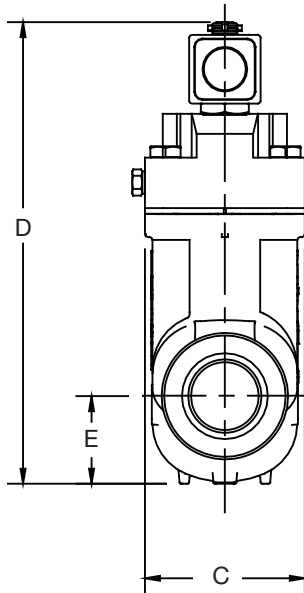
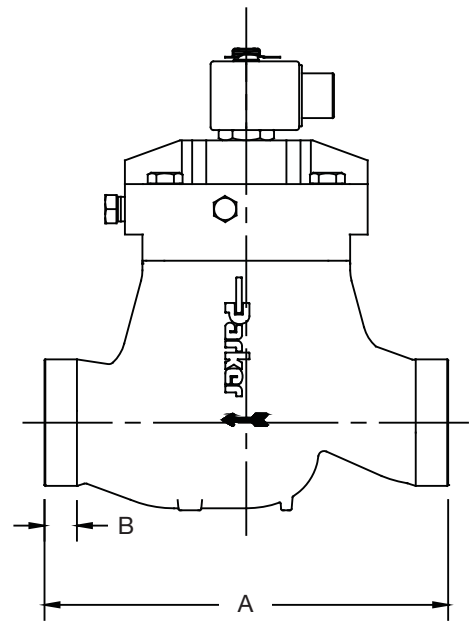
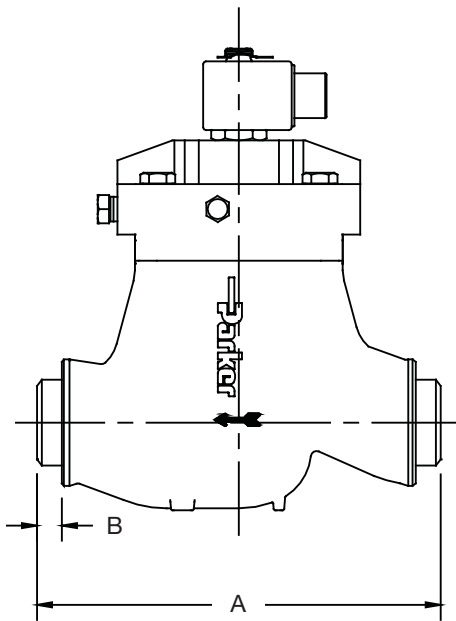
definition, Class "H" coil construction will permit coil temperatures, as measured by resistance method, as high as 185°C. (366°F.) Final coil temperatures are a function of both fluid and ambient temperatures. The higher fluid temperatures require lower ambient temperatures for the maximum coil temperature not to be exceeded. Conversely, low fluid temperatures permit higher ambient temperatures.

A solenoid coil should never be energized except when mounted on its corresponding solenoid tube. The molded Class "H" coil is available from stock with most standard voltages. However, coils are available for other voltages and frequencies, as well as for direct current.

The solenoid coil must be connected to electrical lines with volts and Hertz same as stamped on coil. The supply circuits must be properly sized to give adequate voltage at the coil leads even when other electrical equipment is operating. The coil is designed to operate with line voltage from 85% to 110% of rated coil voltage. Operating with a line voltage above or below these limits may result in coil burn-out. Also, operating with line voltage below the limit will definitely result in lowering the valve's maximum opening pressure differential. Power consumption during normal operation will be 18.2 watts or less.

<p style="text-align: center;">⚠ Caution</p> <p>All personnel working on valves must be qualified to work on refrigeration systems. If there are any question, contact Refrigerating Specialties before proceeding with the work.</p> <p>Before doing any service work, always be sure to disconnect the power and isolate the valve. Failure to do so will result in venting of ammonia.</p>
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Electrical
The Refrigerating Specialties Division molded water resistant Class "H" solenoid coil is designed for long life and powerful opening force. The standard coil housing meets NEMA 3R and 4 requirements. This sealed construction can withstand direct contact with moisture and ice. By



Dimension	Port Size		
	20 - 25 mm (3/4" - 1")	32 mm (1-1/4")	40 - 50 mm (1-1/2" - 2")
A	144.5 mm (5.69")	176.3 mm (6.94")	227.1 mm (8.94")
B	11.2 mm (0.44")	13.7 mm (0.54")	14.0 mm (0.55")
C	90.0 mm (3.54")	90.0 mm (3.54")	90.0 mm (3.54")
D	212.6 mm (8.37")	245.1 mm (9.65")	258.1 mm (10.16")
E	41.4 mm (1.63")	53.1 mm (2.09")	49.3 mm (1.94")

S4W Butt Weld (BW) Dimensions

Dimension	Port Size		
	20 - 25 mm (3/4" - 1")	32 mm (1-1/4")	40 - 50 mm (1-1/2" - 2")
A	144.5 mm (5.69")	176.3 mm (6.94")	227.1 mm (8.94")
B	12.7 mm (0.50")	12.7 mm (0.50")	16.0 mm (0.63")
C	90.0 mm (3.54")	90.0 mm (3.54")	90.0 mm (3.54")
D	212.6 mm (8.37")	245.1 mm (9.65")	258.1 mm (10.16")
E	41.4 mm (1.63")	53.1 mm (2.09")	49.3 mm (1.94")

S4W Socket Weld (SW) Dimensions

Symptom	Probable Cause	Correction
Failure to open or close	Piston jammed due to excessive dirt	Flush clearance space between piston and cartridge bore with refrigeration oil solvent
	Valve Manually Open	Close manual bypass stem by tuning clockwise
	Solenoid seat dirty or eroded	Clean and smooth pilot seat.
	Installed backwards	Re-install regulator in proper position
System Control cannot be maintained - unstable valve operation	Improper solenoid selection: a. Actual load is much lower than regulator capacity b. Actual pressure drop across valve higher than originally intended c. Combination of a and b	Replace cartridge with one of suitable size

S4W Service Pointers

Location	Description (SAE)	Torque mkg (Ft-Lbs)
Port Plate Screws	M10 x 45 MM	(35)
Solenoid Pseudo Assembly	—	Snug
Gages Port Plug	1/4" NPT	1.4 (10)

S4W Torque Requirement Table

Valve	Port Plate				
	20 mm (3/4")	25 mm (1")	32 mm (1-1/4")	50 mm (1-1/4")	50 mm (2")
S4W	3.2 kg (7.0 lbs)	3.2 kg (7.0 lbs)	3.4 kg (7.5 lbs)	3.6 kg (8.0 lbs)	3.6 kg (8.0 lbs)

Socket Weld (SW) and Butt Weld (BW) Valve Weights

Safe Operation (See Bulletin RSBCV)

People doing any work on a refrigeration system must be qualified and completely familiar with the system and the Refrigerating Specialties Division valves involved, or all other precautions will be meaningless. This includes reading and understanding pertinent Refrigerating Specialties Division Product Bulletins and Safety Bulletin RSB prior to installation or servicing work.

Where cold refrigerant liquid lines are used, it is necessary that certain precautions be taken to avoid damage which could result from liquid expansion. Temperature increase in a piping section full of solid liquid will cause high pressure due to the expanding liquid which can possibly rupture a gasket, pipe or valve. All hand valves isolating such sections should be marked, warning against accidental closing, and must not be closed until the liquid is removed. Check valves must never be installed upstream of solenoid valves, or regulators with electric shut-off, nor should hand valves upstream of solenoid valves or downstream of check valves be closed until the liquid has been removed.

It is advisable to properly install relief devices in any section where liquid expansion could take place. Avoid all piping or control arrangements which might produce thermal or pressure shock.

For the protection of people and products, all refrigerant must be removed from the section to be worked on before a valve, strainer, or other device is opened or removed. Flanges with ODS connections are not suitable for ammonia service.

Warranty

All Refrigerating Specialties products are under warranty against defects in workmanship and materials for a period of one year from date of shipment from factory. This warranty is in force only when products are properly installed, field assembled, maintained, and operated in use and service as specifically stated in Refrigerating Specialties Catalogs or Bulletins for normal refrigeration applications, unless otherwise approved in writing by the Refrigerating Specialties Division. Defective products, or parts thereof returned to the factory with transportation charges prepaid and found to be

defective by factory inspection, will be replaced or repaired at Refrigerating Specialties option, free of charge, F.O.B. factory. Warranty does not cover products which have been altered, or repaired in the field, damaged in transit, or have suffered accidents, misuse, or abuse. Products disabled by dirt or other foreign substances will not be considered defective.

The express warranty set forth above constitutes the only warranty applicable to Refrigerating Specialties products, and is in lieu of all other warranties, expressed or implied, written including any warranty of merchantability, or fitness for a particular purpose. In no event is Refrigerating Specialties responsible for any consequential damages of any nature whatsoever. No employee, agent, dealer or other person is authorized to give any warranties on behalf of Refrigerating Specialties, nor to assume, for Refrigerating Specialties, any other liability in connection with any of its products.

